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CACTUS AND SUCCULENT JOURNAL

Of the Cactus And Succulent Society Of America

Vol. VIII DECEMBER, 1936 No. 6

Spiraling ribs on *Euphorbia dinteri* (left) and *E. canariensis* (right). Courtesy EUPHORBIA REVIEW. Plants in the collection of G. A. Frick. Haselton photo.

CACTUS AND SUCCULENT JOURNAL

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Phylogeny of Echeveria

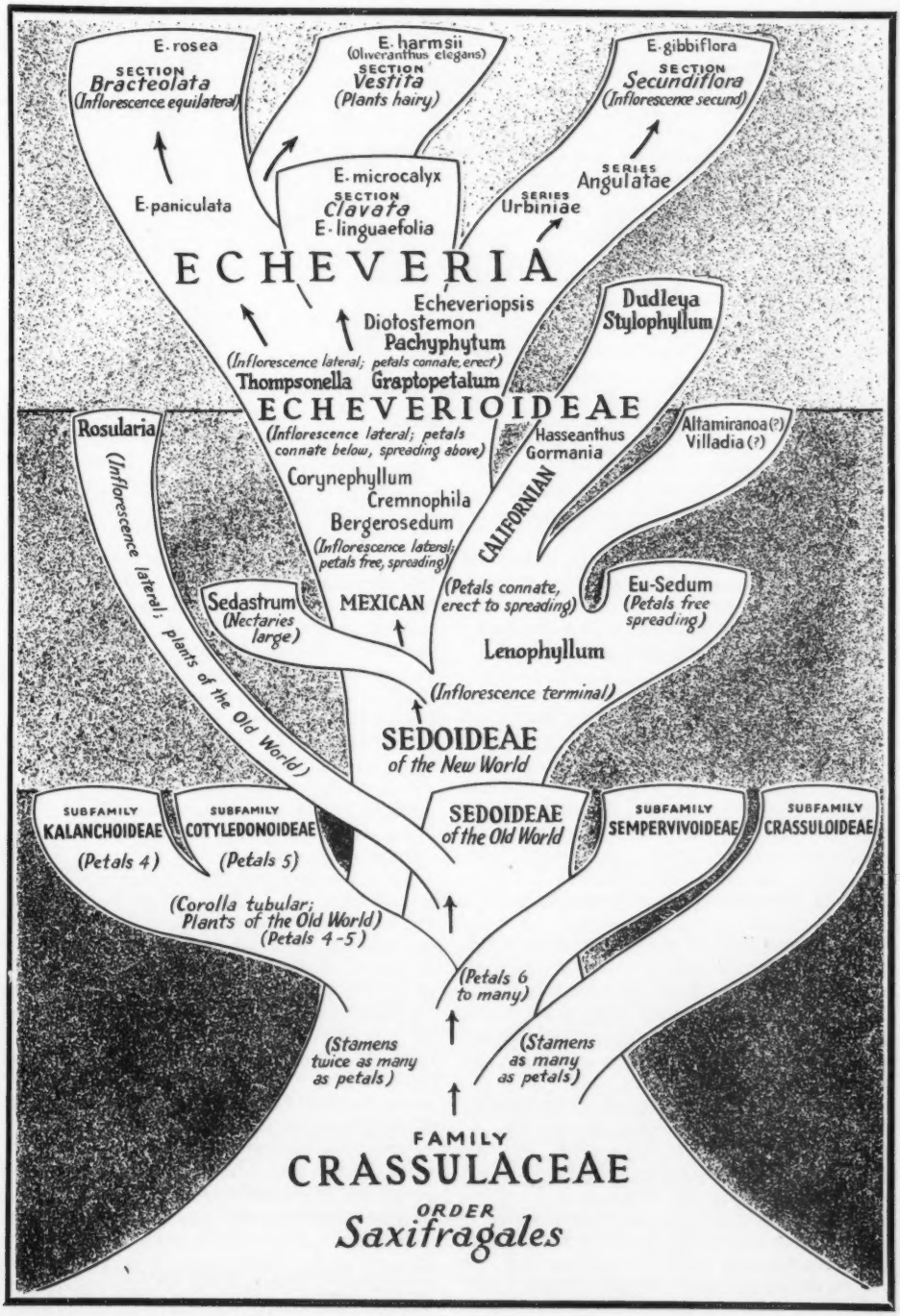
By ERIC WALTHER, *Botanist*
Golden Gate Park, San Francisco

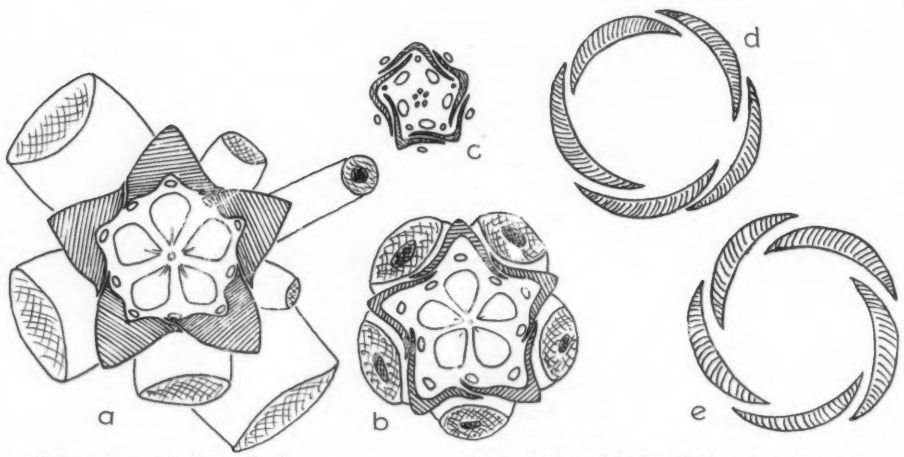
EDITOR'S NOTE: *The following contribution by Mr. Eric Walther is the partial result of several years study devoted to one group of plants. Two field-trips to Mexico and personal visits to most of the large herbaria of North America would seem to qualify the writer for the conclusions submitted in his valued article. Mr. Walther's views are drawn from his extensive accumulated notes, being the preparation for a monograph on the genus* ECHEVERIA, *and he assumes all responsibility for the opinions expressed, whether original with himself or not; this applies particularly to the diagrammatic family-tree. The author would welcome any suggestions and criticism, as well as any material that might aid him in his further studies.*—SCOTT E. HASELTON.

Since the general acceptance of evolution by all serious scientific workers, the most intriguing problem confronting the student of any one group of living organisms is that of their derivation or descent, commonly termed their phylogeny. Of course in the very nature of the subject, no actual observations are ever possible except in a few isolated instances, and therefore, much of our knowledge as to the origin of wild species is necessarily conjectural. Far from being mere wild, unscientific speculation, the conception and clear formulation of a phylogenetic hypothesis frequently proves most helpful in our search for decisive characters on which to base a systematic classification and logical arrangement of the various forms, species and groups. In order to determine the true value of any such theory of descent, it is essential to expose it to the searching test of critical examination, by free and unhesitating publication.

In the course of our study of the genus *Echeveria,* we have always kept this question of descent in mind, and have gradually accumulated numerous observations on comparative morphology, geographic distribution, cytology and genetics, derived from first-hand acquaintance with the species in cultivation and in the field, in herbaria and as published. On these observations we base not only a seemingly natural arrangement of all known species into several well-marked Sections and Series, but we can also arrive at a logical hypothesis of the origin of *Echeveria* from its primitive prototype in the *Sedoideae.*

In the appended diagrammatic sketch prepared with the able assistance of Mr. Clarence L. Clum, we have attempted to present graphically the line of ascent followed by *Echeveria* in its gradual rise from its primitive *Crassulaceous* predecessor. Any such attempt must of necessity suffer from the limitations inherent in any two-dimensional representation of facts really extending into four dimensions, as well as the further handicap of limited space. We have tried to arrange the various genera, etc., in as logical a sequence as possible, but do not wish to imply the direct descent of any one group from the one placed immediately below it. For instance, as


E. rosea
SECTION
Bracteolata
(Inflorescence equilateral)
E. harmsii
(Oliveranthus elegans)
SECTION
Vestita
(Plants hairy)
E. gibbiflora
SECTION
Secundiflora
(Inflorescence secund)
E. paniculata
E. microcalyx
SECTION
Clavata
E. linguaefolia
SERIES
Urbiniae
SERIES
Angulatae
ECHEVERIA
Echeveriopsis
Diotostemon
Pachyphytum
(Inflorescence lateral; petals connate, erect)
Thompsonella
Graptopetalum
Dudleya
Stylophyllum
ECHEVERIOIDEAE
(Inflorescence lateral; petals connate below, spreading above)
Rosularia
(Inflorescence lateral; plants of the Old World)
Hasseanthus
Gormania
Altamiranoa (?)
Villadia (?)
Corynephyllum
Cremnophila
Bergerosedum
(Inflorescence lateral; petals free, spreading)
CALIFORNIAN
Sedastrum
(Nectaries large)
MEXICAN
(Petals connate, erect to spreading)
Eu-Sedum
(Petals free spreading)
Lenophyllum
(Inflorescence terminal)
SEDOIDEAE
of the New World
SUBFAMILY
KALANCHOIDEAE
(Petals 4)
SUBFAMILY
COTYLEDONOIDEAE
(Petals 5)
SEDOIDEAE
of the Old World
SUBFAMILY
SEMPERVIVOIDEAE
SUBFAMILY
CRASSULOIDEAE
(Corolla tubular; Plants of the Old World)
(Petals 4-5)
(Petals 6 to many)
(Stamens twice as many as petals)
(Stamens as many as petals)
FAMILY
CRASSULACEAE
ORDER
Saxifragales



a. Cross-section of *Echeveria*-bud.
b. Cross-section of *Dudleya*-bud at anthesis.
c. Cross-section of *Dudleya*-bud at an early stage.
d. Schematic diagram of aestivation in *Echeveria*.
e. Schematic diagram of aestivation in *Dudleya*.

explained elsewhere, *Cremnophila* could not possibly have been the direct progenitor of *Echeveria*, but belongs on an older, less highly specialized side branch of the main trunk, finally culminating in *Echeveria*. No detailed treatment is possible of the Subfamilies CRASSULOIDEAE, SEMPERVIVOIDEAE, KALANCHOIDEAE and COTYLEDONOIDEAE, all of which are Old World developments from the Subfamily SEDOIDEAE. This last Subfamily is the only one extending to both hemispheres, and it is from its New World members that the Subfamily ECHEVERIOIDEAE has been derived; the latter's distinctive character-combination of a lateral inflorescence with a more or less tubular corolla being unknown in the Old World except in the anomalous genus *Rosularia*.

The various lines of evolution showing trends towards the typical *Echeverioideae* are all indicated in our diagram. It will be noted that neither *Sedastrum*, *Altamiranoa* nor *Villadia* are placed near the direct line of ascent, largely on account of their terminal inflorescences and small, *Sedum*-like flowers.

Our placement of *Dudleya*, so very frequently confused with either *Echeveria*, or *Cotyledon*, or both, deserves further explanation. We are firmly convinced that *Dudleya*, and *Stylophyllum* too, owe their apparent similarity to *Echeveria* to parallel or convergent development due to the influence of similar environmental factors, rather than to any truly close relationship. To the numerous characters we have previously adduced, as indicating the generic distinction of *Echeveria* and *Dudleya* we should add one more, very convincing one. First pointed out to us by Mr. Reid Moran, we have found that a constant difference between these two genera may be found in the manner in which the petals are arranged, most readily seen in the buds when these are cut across with a sharp knife or razor-blade. In *Dudleya* the petals are nearly always so arranged that one of their edges is outside and the other inside, constituting what is termed convolute aestivation. In *Echeveria* we have never found this arrangement, the petals always being imbricate, that is, three have one edge free on the outside, with their other edge inside, while of the other two petals, one is wholly outside all others with both edges free, and the other one is wholly hidden inside the others, with neither edge free. We illustrate this point with the drawings attached both of real cross-sections of the flowers, as well as by idealized diagrams. On this ground, as well as because of geographical distribution and other characters, we feel inclined to consider *Dudleya* and *Stylophyllum* a separate branch of the Subfamily ECHEVERIOIDEAE, possibly derived from forms resembling the modern *Hasseanthus* or *Gormania*.

The more immediate ancestors of *Echeveria* more likely resembled Mexican *Sedum*-like plants with lateral inflorescences and free petals, in part raised to generic rank by Dr. Rose, as *Cremnophila*, *Corynephyllum* and our Subgenus *Bergerosedum*. From these it is a relatively short step to *Thompsonella*, *Graptopetalum* and *Pachyphytum*, which we conceive to be in nearly

the direct line of evolution to *Echeveria.* At some future date we hope to express our views on the phylogeny of the various species of *Echeveria.* At present we indicate merely that of the 4 Sections into which we divide the genus. Section *Clavata* is probably the most primitive, with perhaps *E. linguaefolia,* its least advanced species. Of the other groups only a bare hint could be given of the probable relationships.

Before discussing further our reasons for the present arrangement, we may be permitted to outline the following general principles and concepts that guided us in our evaluation of the more obvious, external, morphological characters.

(A). The members of the Subfamily ECHEVERIOIDEAE (sensu E.W.) are prominently characterized by having a corolla of five more or less connate segments, which have a tendency to become erect and to be brightly colored, with which is coupled an inflorescence that is *always lateral* and axillary; nectaries frequently highly developed; and 10 stamens.

(B). This Subfamily ECHEVERIOIDEAE arose from the more primitive Subfamily SEDOIDEAE, of which it is a comparatively late development found only in the New World. The COTYLEDONOIDEAE on the other hand, strictly confined to the Old World, are more ancient and probably represent a parallel modification due to the influence of similar external conditions. The same applies to the Old World genus *Rosularia.*

(C). Specialization of the ECHEVERIOIDEAE was undoubtedly due to the influence of a distinct pollenizing agent, such as humming-birds or larger insects, as is substantiated by the typical humming-bird color of many flowers, the large amount of honey secreted, its elaborate protection by thickened petals or enlarged sepals, the lengthened corolla-tube, adhesive character of pollen, etc. Once the importance of this factor is realized, its effect can be seen very clearly.

(D). It now becomes possible to trace the connection between this higher type of floral mechanism and the primitive *Sedoid* flower, with its free, spreading, pale petals, small honey-glands and dust-like pollen.

(E). In our reasoning we must give due weight to the tendency of relatively unrelated organisms to assume like forms under the influence of similar conditions, often termed convergence, as well as to the possibility of hybridization in nature.

(F). The possibility that *Echeveria* is of polyphyletic origin, and not of necessity descended from a single progenitor in its immediate past, is more than a mere probability.

(G). While ordinarily complex forms may be considered as derivations from more simple ones, some such apparently simple types as *Echeveria* (Oliveranthus) *harmsii, E.* (Courantia) *rosea,* etc., may represent reduction from formerly more complex ones.

(H). The type of inflorescence, whether secund or equilateral, simple or compound, seems to be of little consequence, since all of these variations occur not only in *Echeveria,* but in most of its closer relations, as well as in the American SEDOIDEAE in general.

(I). Vegetative habit is too obviously an expression of the influence of environment and deserves only minor consideration. Both *Sedum* and *Echeveria* include large and small species, with or without an evident stem, with leaves both large or small, scattered or rosulate, smooth, hairy or pulverulent.

* * *

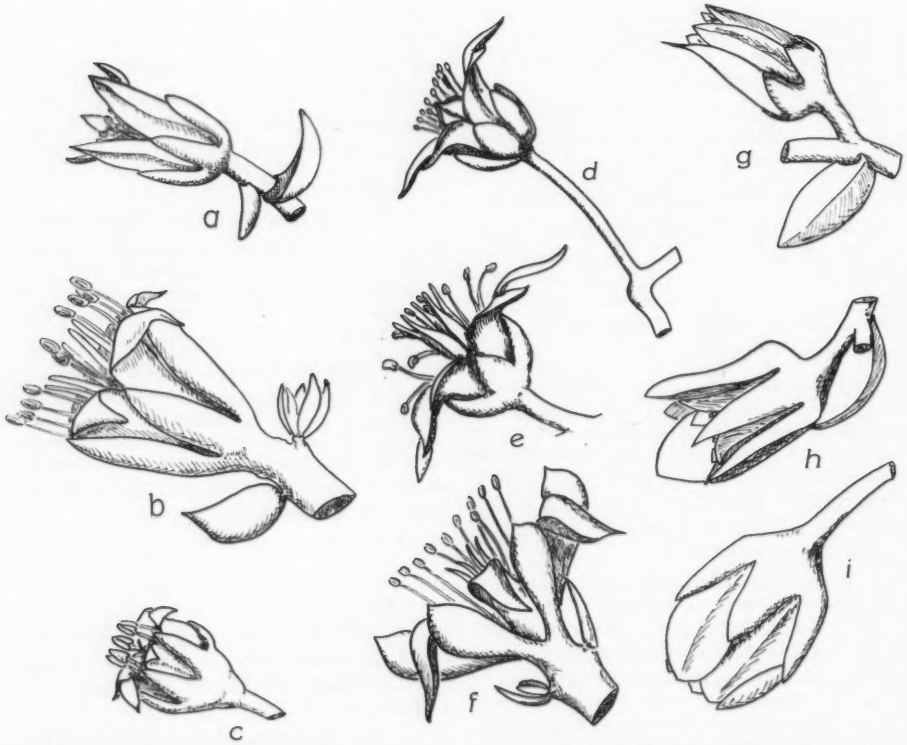
On the basis of the above general principles we may, for our present immediate purpose, group the forms in which we are now interested, as follows:

1. Inflorescence terminal; petals free, spreading above. Typical members of the Subfamily SEDOIDEAE.

Here belong the great majority of *Sedum* species, a number of which may possess one or more of the characters typical of the ECHEVERIOIDEAE, as for instance the enlarged nectaries of *Sedastrum,* etc.

2. Inflorescence terminal, but petals more or less united below and often erect above. Aberrant members of the Subfamily SEDOIDEAE, (as defined by E. W.)

In this group we would find such genera, valid or otherwise, as *Altamiranoa, Villadia,* possibly *Lenophyllum,* and the Californian *Gormania* and *Hasseanthus.* In habit, size, shape, color and internal structure of their flowers, etc., these agree much more closely with the SEDOIDEAE than the ECHEVERIOIDEAE, for which reason we find it expedient to emphasize the character furnished by their terminal inflorescence as a distinguishing one. Undue regard for mere basal coherence of the petals has done much mischief in classification of the CRASSULACEAE, however valuable it may be otherwise to systematic botany.



a. *Altamiranoa elongata* Rose, app. x 4.
b. *Lenophyllum acutifolium* Rose, app. x 4.
c. *Villadia squamulosa* (S. Wats.) Rose., app. x 4.
d. *Graptopetalum amethystinum* (Rose) E. W., opp. x 2.
e. *Stylophyllum sp.*, app. x 2.
f. *Thompsonella minutiflora* Rose, app. x 4.
g. *Dudleya sp.*, app. x 2.
h. *Pachyphytum oviferum* J. A. Purpus, app. x 2.
i. *Pachyphytum compactum* var. *weinbergerii* E. W., app. x 2.

All drawings original except (f.), which is from Rose, and (c.), taken from Saunders *Refugium Botanicum*. Note that (a., b. and c.) are enlarged twice as much as (d.) to (i.).

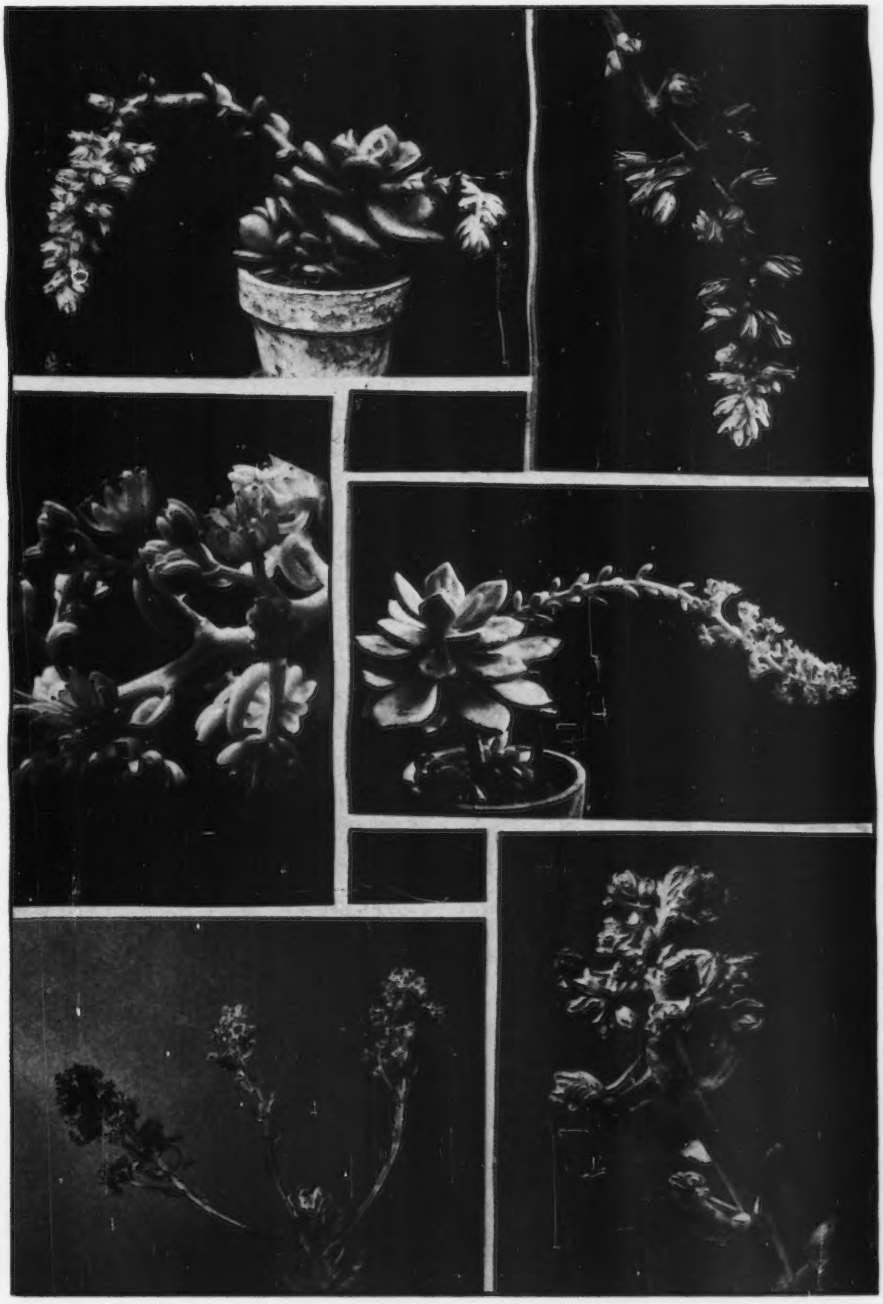
3. Inflorescence lateral, but petals free to base, spreading above. *Sedum* Section *Bergerosedum* EW. (*1)

In its broadest sense this Section of *Sedum* includes Dr. Rose's *Cremnophila* and *Corynephyllum*, as well as A. Berger's *Pachysedum* and *Dendrosedum*, combined by us into the Section mentioned. All of its members are of exceeding interest to all students of the group, and nearly all are now in cultivation by the writer.

4. Inflorescence lateral, petals united at base, but more or less spreading above. Subfamily ECHEVERIOIDEAE proper, with the genera *Thompsonella* and *Graptopetalum*, and perhaps also *Stylophyllum*.

For reasons given above we do not feel that either *Dudleya* or *Stylophyllum* are really close to the direct line of ascent leading to *Echeveria*, but *Thompsonella* and *Graptopetalum* both approach the hypothetical ancestor of *Echeveria* very closely. Of special interest is *Graptopetalum*, since its range in Arizona and Northern Mexico connects the area of *Dudleya* with that of *Echeveria*. It exhibits variations in both vegetative habit and floral arrangements similar to those of *Echeveria;* and all that is needed to make a *Graptopetalum* into an *Echeveria* is for the former's petals to become upright.

(*1: see "Cactus Journal," Vol. II, No. 10, pages 455-457; 1931).



(TOP LEFT) *Echeveria linguaefolia* Lemaire, app. x 0.25. (TOP RIGHT) *Echeveria linguaefolia* flowers, app. x 0.4. (CENTER RIGHT) *Cremnophila nutans* Rose, app. x 0.25. (CENTER LEFT) *Cremnophila nutans* flowers, app. x 1.2. (LOWER LEFT) *Sedum treleasii* Rose, app. x 0.2. (LOWER RIGHT) *Sedum treleasii* flowers, app. x 1.15.

5. Inflorescence lateral; petals united below and erect above, but plants retain some other primitive characters such as small nectaries combined with thin petals not hollowed at base, slender carpels, etc. *Pachyphytum* and perhaps *Dudleya.*

In this group we are approaching very near to *Echeveria* proper; and except for the distinctive petal-appendages of *Pachyphytum* and the aestivation of *Dudleya* it would be difficult to draw the dividing-line here. While *Eu-Pachyphytum* with its large, appressed sepals is distinct enough, *Diotostemon* shows considerable resemblance to some species of *Echeveria,* as the members of our Series *Urbiniae;* and our Section *Echeveriopsis* is, as indicated by its name, so close to *Echeveria* that even Dr. Rose described *P. heterosepalum* under the wrong genus.

6. Inflorescence lateral; petals both united and erect, as well as thick, keeled on back, deeply hollowed within at base, brightly colored without; nectaries large and prominent. *Echeveria* proper.

We have now arrived at *Echeveria,* as that genus is conceived and delimited by us at present, which conception includes within its bounds *Oliveranthus* Rose, *Urbinia* Rose and *Courantia* Lemaire, but not *Dudleya* Rose. The further specialization within *Echeveria* deserves more detailed discussion at some future time. Here we shall content ourselves with considering some remarkable resemblances of what is probably the most primitive species of *Echeveria* to some members of our Section *Bergerosedum* of *Sedum.*

One glance at the photographs here reproduced suffices to prove striking similarity between the three *Crassulaceous* plants in question. Attributed in the past to three separate and distinct genera, in their instance at least it is indeed most difficult to draw any sharp dividing line between *Echeveria* and *Sedum.* As a matter of fact, *E. linguaefolia* might be placed with almost equal propriety into *Sedum,* were it not for the erect petals. Since no definite locality is known for the plant, except that it came from Mexico, we should keep in mind the possibility of its being of hybrid origin. *Cremnophila* Rose is admittedly a very weak genus, based on the inadequate character of its elongated, decumbent inflorescence; by using comparable criteria, *Echeveria* could be subdivided into at least 4 genera.

Dr. H. Froederstroem of Gothenburg, Sweden, now engaged in monographing the genus *Sedum,* agrees with us that *Cremnophila* is invalid and should be reduced to *Sedum.* When recently visiting its type-locality, the Sierra de Tepoxtlan, we were unable to find any plants, our failure being readily understood when we consider the inaccessible nature of the cliffs inhabited by the species, commemorated by the name, which means "cliff-loving." Although we later obtained living plants through the efforts of our guide, Mr. Otis McAllister of Mexico City, our pictures are of plants locally cultivated, by Dr. Koenig of San Francisco; these plants are traceable to Dr. Rose's own collections.

Through the kindness of Dr. D. A. Johansen of Palo Alto we are enabled to add some information on the cytology of the plants involved. Quoting from two of his recent letters we find that:

"—*Echeveria linguaefolia* is a tetraploid species with 48 somatic chromosomes. Chromosomes longish, somewhat curved.

"*Cremnophila nutans*—has 60 somatic chromosomes which are smaller than those of the above-mentioned and broader in proportion. If 12 is the basic or monoploid number of *Echeveria, C. nutans* is a pentaploid form. The obvious conclusion is that the two species are not related cytologically or morphologically. (*2) . . . *Echeveria strictiflora* is the only diploid (*3) *Echeveria* I have yet found; the *Dudleya's* on the one hand are mostly diploids, while the *Sedum's* are mostly tetraploids.—"

In this brief resume we can do no more than just touch upon some of the highlights of a most interesting aspect of *Echeveria.* Even this should be considered merely as a provisional presentation of a possible hypothesis, with which caution we shall close for today.

(*2: Since cytology teaches that plants with 48 chromosomes can not be descended from others with 60, this would tend to show that *Cremnophila,* while no doubt related to *Echeveria,* is a separate offshoot from the same stem rather than a direct ancestor).

(*3: Diploid: in this case meaning "with 24 chromosomes").

THANKS TO THOSE WHO WRITE FOR THE JOURNAL

At this time I should like to speak a word about my admiration for the CACTUS JOURNAL. I think I can truly say that it is the most interesting botanical periodical now being published, and there certainly is a great deal more life in it than in any other botanical publication that I know. I always enjoy it, and read the greater part of it, which is something I can not say of any other similar publication.

PAUL C. HANDLEY,
Field Museum of Natural History,
Chicago, Ill.

PRESIDENT'S COLUMN

Our eighth year is drawing to a close and before we enter the ninth year with all of its glowing promises, it may be well to pause and take a backward glance at the work of this year.

The very first month witnessed the accomplishment of a long sought goal, namely the completion of the incorporation of the Society as a non-profit corporation under the laws of the State of California. This placed the Society on a firm legal footing and brought a number of other benefits including the protection of the officers and members from any personal liability regarding the debts of the Society.

The most important and far reaching accomplishment of the year was the appointment of a Committee on Cactus Nomenclature under the Chairmanship of Dr. R. W. Poindexter. The purpose of this committee is the studying of published names and descriptions of all cactus species, revising and amplifying where necessary with a view to the eventual complete revision of "THE CACTACEAE" by Drs. Britton & Rose. One of our Vice Presidents, William Hertrich, Curator of the Huntington Botanical Gardens has offered the hearty co-operation of that famous institution. Monthly committee meetings are held in his office where a place has been provided for the filing of records and specimens. Living specimens for observation, will be grown in the Botanical Gardens. A printed form for describing species has been prepared and may be obtained upon request from Dr. R. W. Poindexter, 1000 North Temple St., Compton, Calif. Immediate publication of a complete revision must not be anticipated as this committee looks forward to at least five years of work.

NEOMENCLATURE COMMITTEE

Mr. Edgar M. Baxter, Los Angeles, California, Field Explorer.

Mr. Howard E. Gates, Anaheim, California, Horticulturist and Explorer.

Mr. Scott E. Haselton, Editor Cactus Journal.

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Dr. Paul C. Standley, Field Museum of Natural History, Chicago, Illinois.

Dr. Deane Swingle, Department of Botany, Montana State College.

Dr. H. J. Webber, University of California, Citrus Experiment Station, Riverside, California.

Dr. Ira L. Wiggins, Dudley Herbarium, Stanford University.

Secretary Clum spent many hours of quiet labor behind the scenes as well as many more in the preparation of our annual show and other undertakings.

Our Corresponding Secretary, William Surganty, while not occupying a spectacular post, has labored earnestly and well for the benefit of the Society. We are especially glad to welcome the Midwest Cacti and Succulent Society as an affiliate with our National Society. Other affiliations will be announced later by Mr. Surganty.

One of the hardest working members has been Editor Scott Haselton. The highest of tribute was paid him when a prominent scientist and botanist wrote that our JOURNAL is the most readable of any of the scientific publications. Month by month we read our very interesting JOUNALS without thinking a bit of all the skill and hard work that lies behind them. As a personal venture to further our progress, Editor Haselton plans to immediately complete the reprinting of "CACTACEAE" by Britton & Rose and to use the space thus released in our JOURNAL for the mass of popular material he has been accumulating.

The Executive Board has labored faithfully and well. All of the board members have put aside their work to travel many miles to answer the meeting calls of the President.

Our Board Member, Wm. Taylor Marshall, has developed study classes, prepared an illustrated glossary of cactus and succulent terms for publication in the JOURNAL and is now finishing the year with an extended exporation trip on the islands of the Carribbean area. Probably he will bring back many new things and help to clarify old puzzles.

Another Board Member, Don B. Skinner, has developed a number of cactus and succulent study clubs in connection with the Los Angeles City Play-Grounds. These groups have a fine time with their indoor meetings and field expedi tions. They combined to put on a very fine show that was the most heavily attended of any cactus and succulent show of the year.

Our Assistant Editor, Eric Walther, made another of his flying trips (literal as he traveled by airplane) into Mexico to greatly advance our knowledge of succulent plants while Vice President Hertrich journeyed to England to address the Royal Horticultural Society after which he visited many Continental botanical gardens and conferred with leading research workers.

The Affiliated Societies have all done their

part and those close at hand have entertained the rest of us with garden pilgrimages or acted as hosts for joint meetings. While we are speaking of meetings we must not forget the goodly meeting the Orpets and Miss Kate Walker arranged in Santa Barbara or the wonderful picnic in the gardens of Mrs. Fred Bixby in Long Beach.

This issue of the JOURNAL would not be big enough to catalogue all the things of interest and profit that should be mentioned such as the several journeys of Dr. R. T. Craig into Sonora studying Mammillarias; George Lindsay's into Baja California; the four trips of Gustav Starck from the center of Arizona to the Coast to attend our meetings; the monumental 1200 page edition on STAPELIAS that Past President Sloane, and Mr. Alain White have now on the press; and the work of many other individuals and the local activities of our many affiliates.

There have been many activities in the foreign field as well. Count Knuth and Curt Backeberg issued the "KAKTUS ABC" which is not a cactus primer, but the most complete listing of cactus species in print. Curt Backeberg made another of his exploration trips into little known parts of South America while Harry Blossfeld spent his second season in exploring another portion and we hear Prof. Helia Bravo has a book in publication on the cactus of Mexico.

The year has witnessed the general acceptance in Europe of Backeberg's revision of Britton & Rose's generic outline which will lead to the elimination of much confusion in cactus names and classifications.

The interest in our hobby is world wide and ever spreading. We must send greetings to fellow societies in Australia, Japan, Great Britain, The Netherlands, Belgium, Germany and Czecho Slovakia as well as to individuals under every flag.

Personally, I am indebted to our entire membership for hearty and harmonious co-operation.

With a Merry Christmas and a Happy New Year.

HOWARD E. GATES, *Anaheim, Calif.*

WEST INDIAN ECOLOGICAL EXPEDITION

The expedition landed on the morning of the 17th of November at Puerto Plata where a most cordial welcome was extended by our good friend and associate, First Sergeant H. E. Hurst, in whose beautiful home we are now residents.

The first day was spent in viewing Hurst's large collection of West Indian Cacti, Orchids, Water Lilies and native exotic plants. The home is new and modern in every respect and forms a perfect background for our charming hostess, Mrs. Hurst.

Yesterday we left at 6 a. m. in Hurst's Lincoln and took the road to Monte Christi on the Haitain border, stopping frequently after we reached the arid section to inspect cactus and orchids, which are always associated. The columner types of cacti act as hosts to the orchids.

We recognized three distinct species of *Cephalocereus,* two *Lemaireocereus,* ten *Opuntias,* two *Harrisias, Mammillaria prolifera, Melocactus lemairei,* at least three *Hylocereus* and a confusion of *Selenicereus* from which at least four species stand out.

As Britton and Rose refer only one species of *Cephalocereus,* namely *C. polygonus,* to Hispanola it seems obvious that the other two species are unknown, unless they have been described since the publication of "THE CACTACEAE;" if this proves to be the case, the two new species will be dedicated to President Trujillo of Santo Domingo, whose government has shown great interest in and assistance to the Expedition, and to Mr. Hurst, whose knowledge of the country and the people greatly aided our efforts. These are the only two exceptions we contemplate making to our rule of using descriptive or geographical names for new species.

Santo Domingo has no poisonous snakes, in fact, few snakes of any type, but other obstacles are substituted that the lot of the ecologist may not become too easy. Very large tarantulas, scorpions and centipedes are plentiful, but the little bush hornet merits more attention from explorers, constantly evincing a desire to sit down on some portion of ones anatomy.

Soon we will move over to Monte Christi which is in the best cactus belt to more easily collect and identify species. Later our headquarters will be moved into Haiti.

As I write this on the front porch of Hurst's hacienda, which is of rock and concrete construction, I face a collection of cacti in pots on the rock walls, over which I see the spacious lawn, outlined with Royal Palms, Hibiscus and Coleas. A large hedge of *Cereus hexagonus* serves to set off the large pool of immense tropical water lilies around which stand four egrets anxious to dine on the tropical fish in the pool.

A pair of handsome Macaws converse in Spanish, doubtless making derogatory remarks anent the "Loco Botonica" who wastes the beautiful morning writing when he should be identifying the specimens collected yesterday. So to avoid any further unfavorable comment I will now do that very thing.

Hasta la vista. W. TAYLOR MARSHALL.

GROWING SUCCULENTS IN AUSTRALIA

By R. W. FIELDS, *Australia*

Large Opuntia on which has been grafted many species of cacti which flower at different times.

In this country, cactus growing is in its infancy. It is only during the last three or four years that our mutual friends have become at all known, but we old timers who had to plod along for many years without much sympathy are well satisfied with the program and with the formation of our Cactus Society. We feel sure of the call going ahead in leaps and bounds.

In this country we are fortunate in being able to grow many cacti and succulents in the open and in this particular spot we are "blessed," (of course writing as a cacti grower), with a particularly low rainfall thus lessening our difficulties. For many years my struggles in the art of cacti culture were carried on near Melbourne with an average rainfall of 25 inches, most of it in winter with low temperatures. Coming here—150 miles north—to grow wool and cacti—or cacti and wool—I am in a belt of plain country cut off from the costal changes of Melbourne by The Great Dividing Range and with an average rainfall of 16 inches. Most cacti thrive under this condition—the growth is wonderful—as is also the appearance of the plants.

The soil here is shallow and of a claylike nature—against all the rules and regulations for cacti growing—but nevertheless all the stronger growing sorts seem to flourish to perfection. For the more delicate ones I build up a more open mixture.

From late spring until early autumn the plants are irrigated about every 10 days—unless rain falls—by running water through shovel width drains. Everything gets a good soaking and as soon as the surface is dry enough to work the ground is cultivated. The sun's heat here is very severe—weeks on end, with warm nights. With the exception of a few shade lovers, our friends never turn a "hair" providing the moisture is kept up to them. Without this latter, however, even well established Opuntias and Cereus get limp and lose interest in life. In many parts of this state, Opuntias were planted as boundary fences half a century ago. These still remain as planted—just dividing fences. Our low summer rainfall is not sufficient to start seed or root cuttings which simply get baked up by the sun's heat. In Queensland and part of New South Wales, however, Opuntias have claimed many millions of acres of good land. The congenial climate with a summer rainfall of up to 50 inches allowed them to take advantage of all their huge vitality and it is only of late years that the "pear pest" has suffered a reverse and is rapidly losing ground to the onslaught of Cactiblastis and Chelinigea Co., Ltd.—the Lord preserve our collections from these reptiles.

The following appeared in a local paper:

CACTOBLASTIS

Chelinigea, Cactoblastis
Are the little chaps to deal
With the Prickly Pear. The last is
Also known as Cochineal.
And tho' pests for long have racked us—
They're the blokes to blast the Cactus.

Tho' the Cactus, crying "Mea
Culpa," for compunction plead,
Savagely Chelinigea
Gobbles it with horrid greed,
Till appears a passing fair land
Where once spread a tangled pear land.

So, abandoning disguises
Cactoblastis chews away,
Till another problem rises
To confront another day:
When the pear pest in the past is,
Who will blast the Cactoblastis?

The photo herewith shows an Opuntia with grafts and is indeed, a picture. The *Zygocactus* start the flowering off and gives us some weeks of high color—carmin and white—followed by *truncatus?* (The names—B. & R.) Quite a number of other authorities are oft consulted in our public library, but we learn not to be quite definite about many things in connection with cacti! Back to our Opuntia: November sees a dozen distinct Epiphyllums adding to the picture, followed by *Aporocactus flagelliformis, Mallisonii, Chamaecereus silvestrii,* and *Echinocereus berlandierii* which are grafted on *Nyctocereus serpentinus* alongside. This Opuntia was started off by me in 1920, later taken over by my father, who is shown in the picture, who continued with the grafting. It has been responsible for quite a few converts and each year continues to make a few more.

The cold and wet of the southern parts of this state make protection during the winter months essential for quite a few species. Here, although our frosts are much more severe than in the South, the dryer conditions seem to make all the difference. Autumn is usually a dry season, and plants ripen off well and are able to weather through the winter.

Pests to date are few. Mealy bug and scale are the only ones that have come our way. This season has been particularly favorable for the development of mealy bug, and all growers seem to have been at war against them. However, with plants growing healthily in the open ground there is very little trouble with either of these.

OBSERVATIONS FROM G. F. ANTON, PUERTO RICO

My experience and experiment with cactus culture in the past five years has been such that would make all the old timers turn over in their graves. I have violated every accepted dictum in cactus culture. I have deliberately done so to see what would happen, and yet I have the healthiest looking plants as a result.

Three years ago I read somewhere that "cactus plants will not thrive in a wet climate." At once I set out to test this theory. I collected some forty species, over 500 plants in all, and planted them in a locality where the annual rainfall is over 80 inches. Whenever it did not rain for a week or more, I would send the boy out with a hose to soak down the cactus garden. To-day the very same plants have grown into thickets despite the regular pruning they get. Mark, however, that in preparing my plot I placed first about four inches of gravel and on top of that about eight to ten inches of the soil that I prepared for my plants; this of course meant perfect drainage.

Another commandment was that "stable manure will rot cactus plants away." About two years ago I called for three cubic years of clean stable manure; this was spread over an area of 23 ft. by 50 ft., which is the size of my experimental garden. Last Fall I spread over the same area two more cubic yards of stable manure. Not one plant has died on me yet; on the contrary the growth of my plants is phenomenal. The observation which lead me to believe that this was an error was this: In my collecting trips I observed that the plants around places where there were a lot of goats grazing seemed to be healthier and more vigorous. On close examination it was found that the roots of some of these plants would grow very profusely around these manure piles.

The third commandment broken was that of soils: The general understanding has been that cactus plants will thrive on very sandy soil. Two years ago I visited my friend H. O. Bullard's collection in Hackensack, N. J. I noticed that most of his plants were planted in a reddish sand, with hardly any humus in it. His plants looked starved and yellowish. I suggested that he use some sheep manure and leaf mold on his beds. A year later I visited his place again, and I was very pleasantly surprised to find his collection a thousand per cent better looking than the year before. Pictures of this collection have appeared in the JOURNAL and testify as to that.

Four years ago Dr. N. L. Britton assisted Cap't. Heylman, from San German, Puerto Rico, to set out a cactus garden. He, Dr. Britton, insisted that a shale and clay formation was good enough soil for cactus plants. Being in the presence of so eminent an authority, I had to accept his wisdom without comment. During the four years almost all of those plants looked pale and sickly, with very little growth, if any. Last December I made a wager with Captain Heylman that if he would use goat's manure on his cactus garden and any of his plants died, that I would replace them for him with better looking plants. We spread a layer of three or four inches of manure, sand, and black loam, in equal parts, on top of his cactus beds without disturbing the plants.

Then we watered them about once a week whenever it did not rain. Now, six months later, every plant in that garden has new growth on it. Plants that were dormant for four years burst forth with new life. And here my reasons for disobeying the sages had been my observations made in the field: I have noticed that our cactus plants grow mostly on the rocky coast. At first one would think that they live actually on the rocks, but on closer observation it will be found that the roots of these plants are to be found among the crags and depressions of the rocks where leaf mold soil and animal manure collected by the rains form the richest kind of soil for them. I have actually dug out plants from the rocks to find their roots clinging to a type of soil that would please the most fastidious gardener for richness and friability. And, of course, the rocks with their crags and fissures gave the perfect drainage necessary to prevent water stagnation.

Another observation: My collection had been abandoned for over a year, from June 1934 to August 1935. Grass and weeds grew all over the place. In August 1935, most of the plants looked pale and undernourished. I set out to clean the weeds and grasses; after cleaning the plot out once, I would pull up every blade of grass as fast as it would show its face above the ground surface. Picture the job I had in a place with 80 inches of rain-fall and plenty of sun light. In four months time, it was noticed that all plants began new growth, and almost all lost their paleness. Now, nine months later, there is not one yellow plant on the lot, and the growth is marvelous. The explanation given is as follows: Evidently the cactus plants must be slow in absorbing their plant food from the soil. On the other hand grasses and weeds, being seasonal plants, must absorb their plant food very much more rapidly than the cactus plants. Therefore, when you put the two together, the slow eating fellow is bound to suffer from malnutrition; because his fast eating companion will eat all there is in the soil and leave nothing for him to feed on. Hence the moral: Keep weeds and grasses off of your cactus garden if you want your cactus plants well fed.

REVISION OF THE GENUS ECHINOCEREUS

I am making a careful study of the genus *Echinocereus* having in view a revision of the genus. For this work I am very anxious to acquire specimens of the various species from as many localities as possible. In this way I hope to check on possible errors in names and descriptions. I expect to write a key in such a way that species may be more accurately determined from young plants, plants which flower infrequently as well as from floral characters. I shall be pleased to have the co-operation of all people interested in cacti in order that I may have information on habitats, variations in forms and specimens from all localities possible. The University of Michigan Botanical Gardens will be glad to co-operate with anyone making a similar study of other genera in the CACTACEAE, and will send out any specimens available for such a study.

ELIZADA U. CLOVER,
Curator of cacti, Botanical Gardens,
University of Mich.

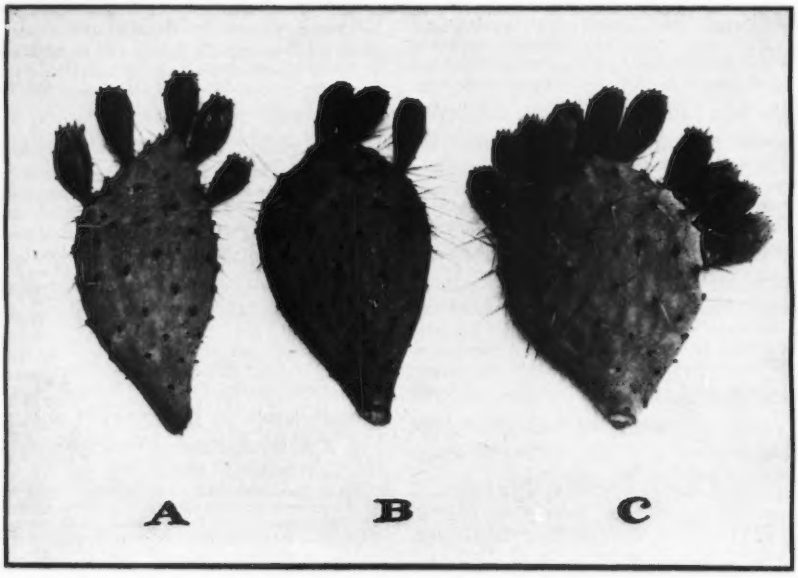
BOOK REVIEW

THE CACTACEAE OF CALIFORNIA, by Samuel Bonsall Parish. In Jepson's Flora of California, Vol. 2, 1936. Associated Students Store. Berkeley, California. $7.00).

There was published on September 17 the final parts of the second volume of Jepson's Flora of California. To this volume S. B. Parish contributed the account of the family CACTACEAE. His presentation of the genera and species differs markedly from that of some others and may well serve as the basis for a few words of comment upon the author himself, who has been dead now some nine years. Mr. Parish spent by far the greater portion of his life as a resident of Southern California, and during many decades he explored with great interest and zeal every region in that vast territory. No one in his time had anything like the field knowledge of California CACTACEAE that he possessed. He may be spoken of, in a sense, as a local botanist in Southern California, and yet, in another sense, he was during his whole life always a world botanist with a world outlook. He had small sympathy with the point of view of those who specialize on a single genus or a single family without any reference to the rest of the plant kingdom,—men permanently at the bottom of a narrow trench who neither see nor know aught of the terrain bounding the trench. As might be expected then Mr. Parish's treatment of the CACTACEAE of California in the Flora of California is not only scholarly and cultivated, but in addition the sign of a man whose interest in the flora of the earth as a whole was very great and very penetrating—an interest which is wisely reflected in what he wrote on the native vegetation of Southern California.

In the arrangement of his matter he naturally follows the plan of the Flora of California in general. There will be found not only generic and specific descriptions, keys to the genera and to the species, and indications of range of species, but also a paragraph devoted to localities in which are cited stations in support of the range and validated by the names of collectors and their field numbers. In addition there is a bibliography, and also bibliographical references for each species. In every case the original place of publication for a species is given and an indication of the type locality. Similar factual matter is afforded for the synonymy. This account may well be studied by all those persons interested in CACTACEAE who have a scientific viewpoint. In addition to the CACTACEAE this volume also contains an account of those species of the family CRASSULACEAE which are native to California.

W. L. JEPSON.



A RED-FLOWERED OPUNTIA ENGELMANNII?

By ROBERT S. WOODS

While visiting Zion National Park in 1927, I received from Dr. A. M. Woodbury, then Park Naturalist, a *Platyopuntia* joint said to be from a red-flowered species growing somewhere in that vicinity. After raising the resulting plant to the fruiting stage, I found that it did not correspond to any of the species attributed to the Zion Park region. Of the *Platyopuntias* described as having red flowers and juicy fruit, it is nearest, both botanically and geographically, to *O. vaseyi* of the Pacific slope of southern California, but the two differ materially, when grown under identical conditions, in size, shape and color of joints, color of spines, shape of fruit, and to some extent in form and color of flowers. No photograph or description of the Utah plant in its native habitat is available, but a specimen growing in a dry, gravelly portion of my garden at Azusa, California, may be described as follows:

Plant spreading and branching freely, lower stems procumbent, others ascending. Joints up to 12 inches in length, obovate to rhombic, usually more or less pointed, glaucous bluish green, becoming greener in age. Areoles about 1½ inches apart, bearing one acicular spine about 1½ inches long and one or two shorter ones. Glochids and bases of spines golden brown, rest of spines white. Flowers numerous, large, opening widely; petals light salmon red, style, filaments and anthers white, stigmas light green. Fruit juicy, about 2½ inches long, often attenuate at base and slightly constricted near the apex, bearing glochids and small spines; umbilicus depressed; surface between areoles smooth, dark purplish red, overlaid with glaucous bloom.

In the accompanying photograph, *A* represents a typical joint of this plant. *B* and *C* are typical joints of yellow-flowered plants collected in central and southeastern Arizona, respectively. Neither of these latter forms corresponds exactly to any described in THE CACTACEAE, but both seem nearest to *O. engelmannii*, which, according to Britton and Rose, "has been more confused than any other species of *Opuntia*." These authors also state that they "are still uncertain as to its specific limits," and that "Dr. Rose was inclined at one time to separate the Tucson plant, which seems to have some just claims for specific recognition, but there is a mass of herbarium material which seems to connect this with the true *O. engelmannii*." The distinguishing characters of the "Tucson plant" are not mentioned, but the form *C*, which is common in that vicinity, is peculiar in that a large proportion of its spines are bent, curved or twisted. The joints

are large, broadly obovate, uniformly green, not glaucous, and the spines are reddish brown, becoming lighter toward the ends. The form *B*, obtained north of Prescott, differs in the more narrowly obovate joints, grayish green color, and the greater amount of white on the spines, which are nearly straight. Both are large, spreading plants of rapid growth which bloom freely. Their flowers seem identical with those of form *A* except in the color of the petals. The fruit of *A* is usually rather more slender and appears bluer because of the glaucous bloom.

As may be seen, the form *B*, which most nearly resembles the description of *O. engelmannii*, seems to be intermediate between the quite dissimilar plants *A* and *C*, as well as occupying a geographical position midway between them. A large expanse of high plateau intervenes between the habitats of *A* and *B*, but whether or not intergrading forms exist, it seems to the writer that the closest relationship of the Utah plant is with *O. engelmannii*, bearing in mind the facts that color of flowers is not always a diagnostic character and that this species is known to be a widely distributed and variable one.

OKLAHOMA FLOWER SHOW

The Cactus and Succulent Society of Oklahoma are very proud of the showing they made at the State Ameturs Fall Show held in Oklahoma City, October 17th and 18th. The dry summer months had resulted in a scarcity of fall flowers and the success of the show was dependent on the beauty of plants more than the blossoms. The cactus and succulents fitted into this arrangement and our plants were, naturally, the most interesting part of the show.

The painting of a desert landscape, by Mrs. S. P. Seela, furnished the background panel for the cactus display and was the outstanding feature of the show. Mrs. Marjorie Lee received twenty-five premium ribbons and a special award trophy. Other exhibitors received their fair share of the honors.

As a result of the exhibition, more people realize the beauty of these plants as pot specimens and accept the fact that they have a place in landscape gardening.

R. A. CHUBB.

A CORRECTION

Kindly make the following changes in your November JOURNAL, Vol. VIII, No. 5, pages 68 and 69. Illustration numbers should be changed as follows: Number 4 change to number 2, number 2 change to number 3, number 3 change to number 4. We regret our error in Dr. Long's excellent article.

FROM A FAR AWAY COUNTRY

The Cactus Society welcomes new member Mrs. Cyril H. Haas of Turkey. We have members in almost every land, but Mrs. Haas is our first member in Turkey. Miss Grace H. Stowe of Japan has just joined our Society and we hope to hear about the cacti collections of that country.

Britton and Rose Reprint

During the month of December each member of the Cactus and Succulent Society of America will receive a letter stating complete details regarding the immediate completion of the reprinting of THE CACTACEAE. This issue of the CACTUS JOURNAL contains its final installment, but arrangements can be made to complete your Vol. II instead of waiting another two years. Now is the time that this monumental work is needed for reference and large sums have been expended in order to give you these volumes.

Space in the JOURNAL is needed for the interesting new material which is most generously contributed from all parts of the world. Now we wish to encourage more articles on experiences, culture, glass houses, common names, field trips, new species and illustrations. Take a part in editing your magazine and make 1937 issues the finest ever published.

SCOTT E. HASELTON, *Editor.*

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3. Hints on Cacti. A. Blanc & Co., Philadelphia, Pa., U.S.A., 1888.

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